United States Patent [19]

Hench et al.

[11] **4,159,358**

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[54] **METHOD OF BONDING A BIOGLASS TO METAL**

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[73] Assignee: **Board of Regents, State of Florida,** Tallahassee, Fla.

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[51] Int. Cl.^{2} **B05D 3/02**
[52] U.S. Cl. .... **427/318; 3/1.9;** 3/1.91; 3/1.911; 3/1.912; 3/1.913; 65/59 R; 128/92 C; 128/92 CA; 427/330; 427/398 R; 427/435; 428/432; 428/433; 428/434
[58] Field of Search .... 427/398 R, 435, 330, 427/318, 374 F, 376 C; 428/432, 433, 434; 65/59 R; 128/92 C, 92 CA; 32/10 A; 3/1.9, 1.91, 1.911, 1.912, 1.913

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[57] **ABSTRACT**

A method of bonding a bioglass layer to a metal substrate comprising heating the metal substrate having a roughened, oxidized surface to about a temperature at which the expansion of the metal is substantially equal to that of the bioglass at the temperature above which the thermal expansion of the bioglass is non-linear, immersing the heated metal surface in molten bioglass, the time of immersion being of such duration that the temperature of the metal does not rise substantially above the temperature to which it is heated, allowing the coated substrate to cool whereby the bioglass layer is bonded to the metal substrate by ion diffusion and thermo-mechanical stresses in the bioglass and metal layer are relieved at a substantially equal rate and the product produced by said process.

18 Claims, 3 Drawing Figures
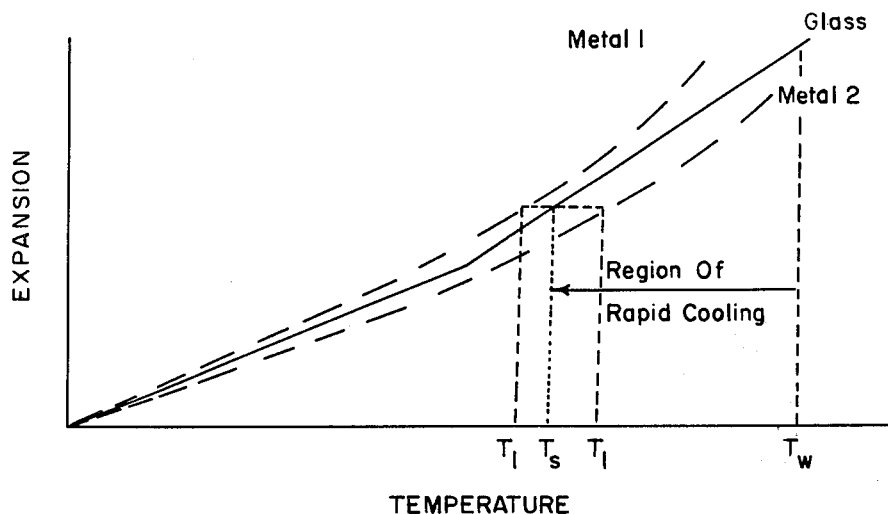
Schematic showing how two different metals can be coated with the same glass. Immersion takes place at working temperature, T_w. The glass then cools rapidly to near the softening point, T_s. The T_I's for the metals are chosen so that volume expansion for both glass and metal are equal. Slight variations in T_I are made to vary surface stresses.